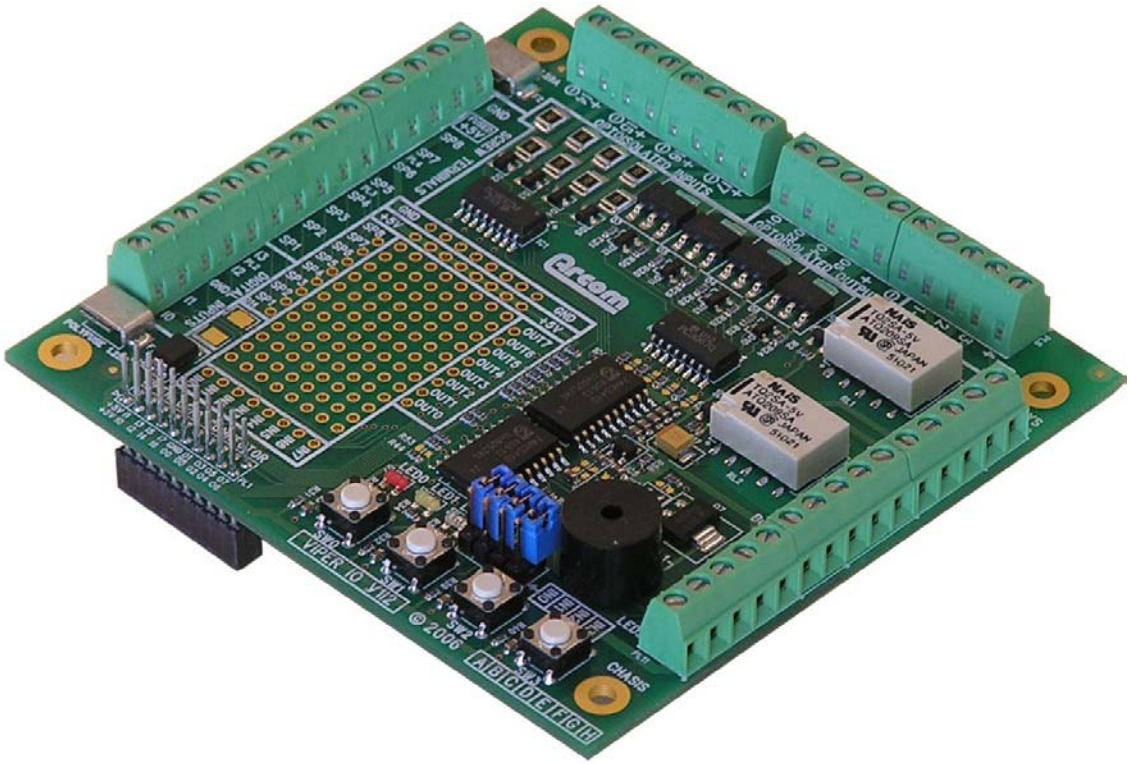
VIPER-I/O

Technical Manual



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Revision history

Manual	*PCB*	*Date*	*Comments*
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Introduction

VIPER-I/O is a low cost add-on I/O module for the PXA255 board VIPER. The board provides a variety of I/O features without the additional costs of a full PC/104 interface. The combination of the VIPER and VIPER-I/O is suited to controlling and monitoring applications which require a limited number of isolated inputs and outputs.

For information about ordering boards, please contact a member of the Arcom sales team. See Appendix A - Contacting Arcom, page 35.

Variants

There is only one standard variant of this board, referred to as the VIPER-I/O.

Default configuration for the GPIO input port (from the VIPER) is 0xFFh. An alternative version using 0x00 is available for volume orders. Please contact the Arcom sales team (see page 35) for pricing and availability.

Handling your board safely

Anti-static handling

This board contains CMOS devices that could be damaged in the event of static electricity being discharged through them. At all times, please observe anti-static precautions when handling the board. This includes storing the board in appropriate anti-static packaging and wearing a wrist strap when handling the board.

Packaging

Should a board need to be returned to Arcom, please ensure that it is adequately packed, preferably in the original packing material.

Use an anti-static bag for the board and use a box (rather than a bag) to physically protect the board.

An anti-static bag is not required if the board is being returned in the original development kit box, which has an anti-static foam interior.

Damage caused in transit may invalidate a warranty claim.

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Electromagnetic Compatibility (EMC)

The VIPER-I/O is classified as a 'component' with regard to the European Community EMC regulations and it is the user's responsibility to ensure that systems using the board are compliant with the appropriate EMC standards.

RoHS compliance

The European RoHS Directive (Restriction on the use of certain Hazardous Substances - Directive 2002/95/EC) limits the amount of six specific substances within the composition of the product. The VIPER-I/O and associated accessory products are available as RoHS-6 compliant options, identified by an -R6 suffix in the product order code. A full RoHS Compliance Materials Declaration Form is included in Appendix , page 38. Further information about RoHS compliance is available on the Arcom web site at www.arcom.com/RoHS_and_WEEE.

About this manual

This manual describes the operation and use of the VIPER-I/O board. It is designed to be a reference and user manual and includes information about all aspects of the board.

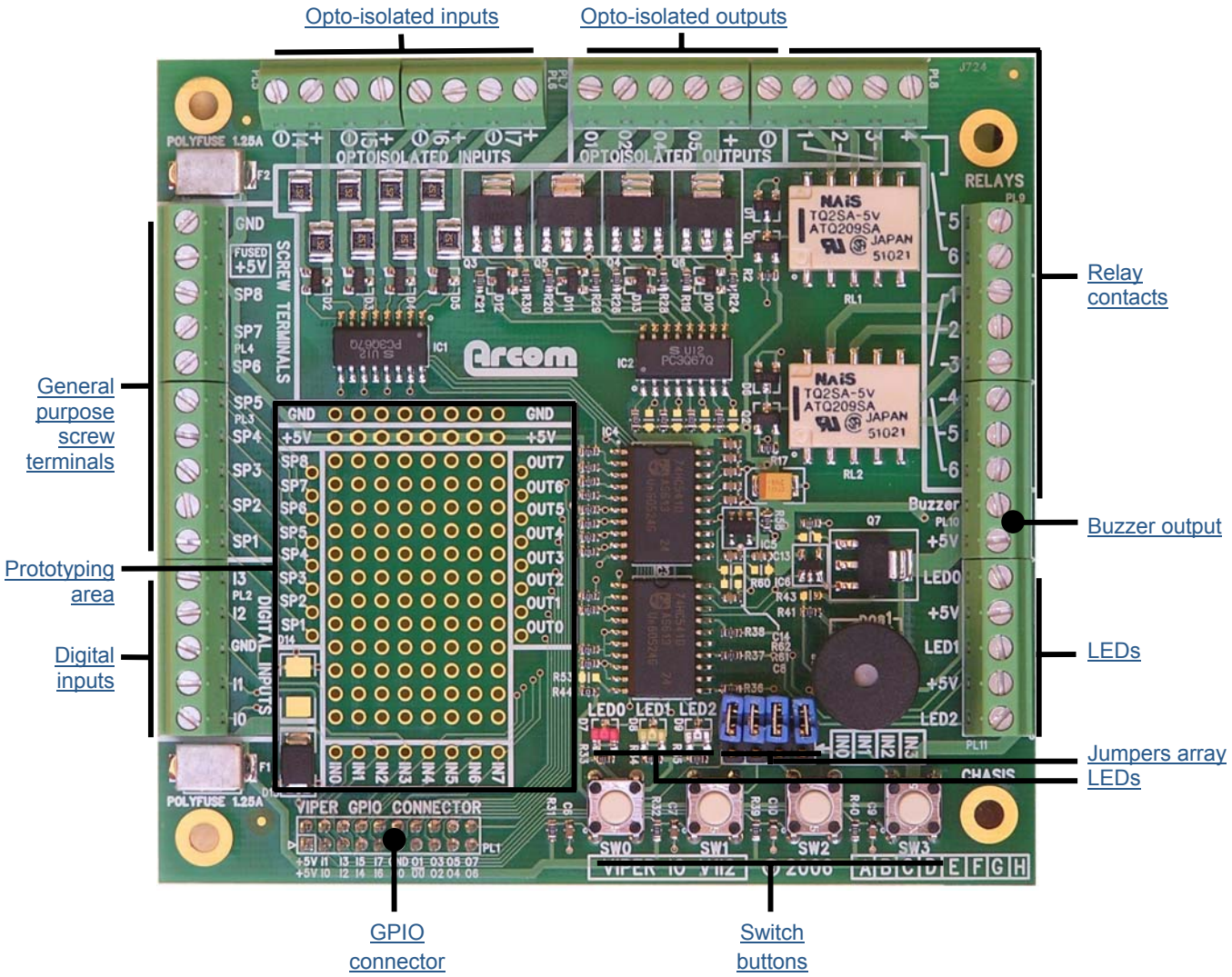
Symbols

The following symbols are used in this guide:

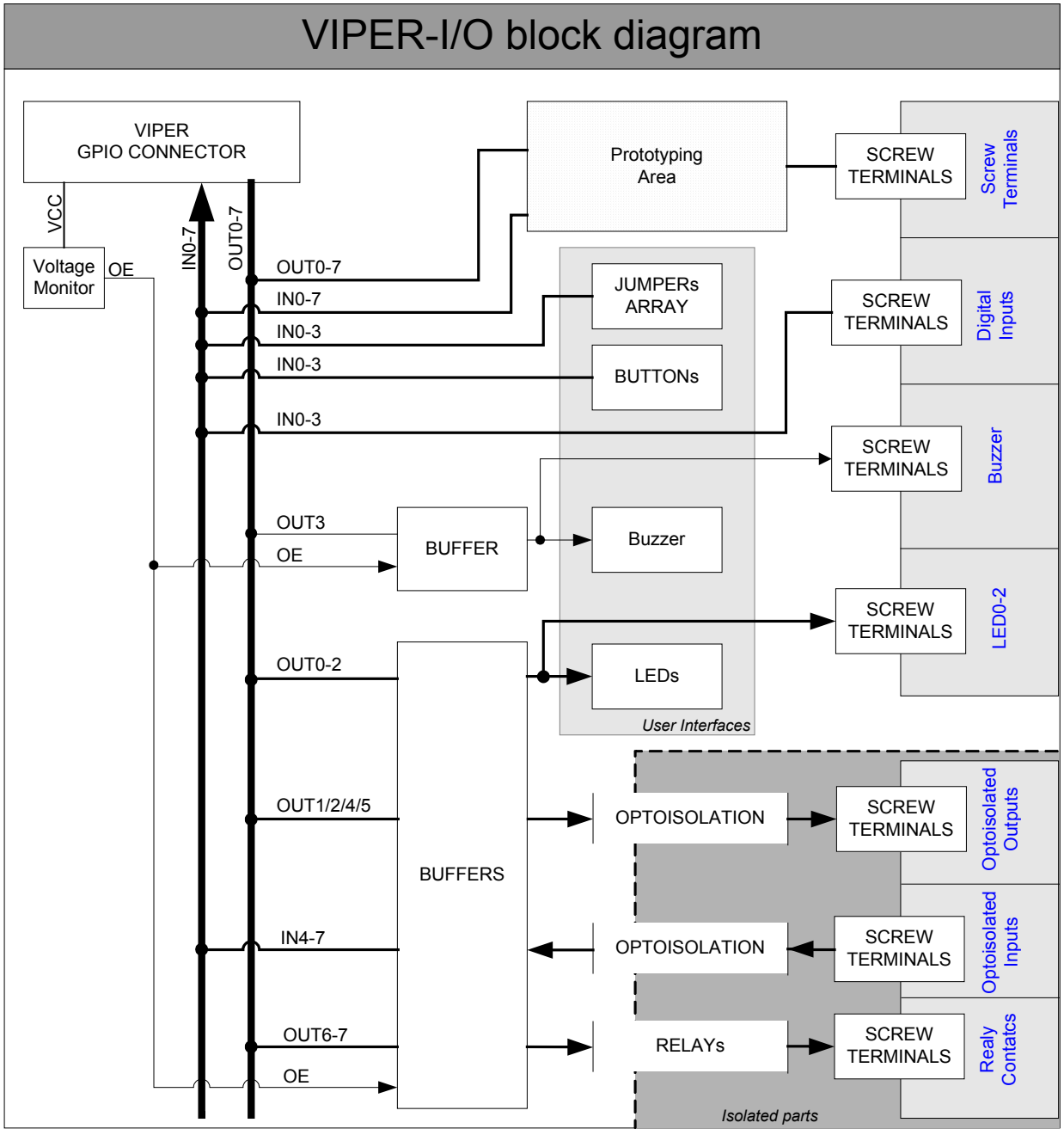
Symbol	Explanation
	Note - information that requires your attention.
	Tip - a handy hint that may provide a useful alternative or save time.
	Caution – proceeding with a course of action may damage your equipment or result in loss of data.
	Jumper is fitted.
	Jumper is not fitted.

VIPER-I/O 'at a glance'

The following image shows a picture of the board. Click on each callout for more information.



Block diagram



Features of the VIPER-I/O board

The main features of the VIPER-I/O are detailed in the following sections.

Digital inputs/outputs

- GPIO connector - for direct connection to the VIPER.

Opto-isolated inputs

- 4 x opto-isolated inputs (+5V ~ +30V).
- Reverse input protection diode.

Opto-isolated open-drain MOSFET outputs

- 4 x opto-isolated open-drain MOSFET driver outputs (+5V ~ +30V).
- Reverse power supply protection diode.

Relays

- 2 change over relays (12 x relay contacts).

LEDs

- 1 x user LED (red), 2 x user/output LEDs (yellow and green).

Switches

- 4 x user switches (push-button).

Buzzer

- User controlled buzzer.

Power

- +5V DC power input from the VIPER board.
- Reverse power supply protection diode, 1.25A polyfuse, short circuit protection.

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Dimensions

- 95mm x 90mm x 12mm (PC/104 size footprint).

Isolation

- Up to 1000V isolation (operational/functional) between PC/104 based control system circuit and system under control. (Minimum clearance/creepage is 1.2mm.)

Temperature

- -25°C to +70°C (-13°F to 158°F) operating temperature range.

What items are provided?

When you purchase the VIPER-I/O, you receive the following items:

- The VIPER-I/O board itself.
- 250mm cable to link VIPER to VIPER-I/O.
- 4 x PC/104 stand-offs, screws and shake proofs.

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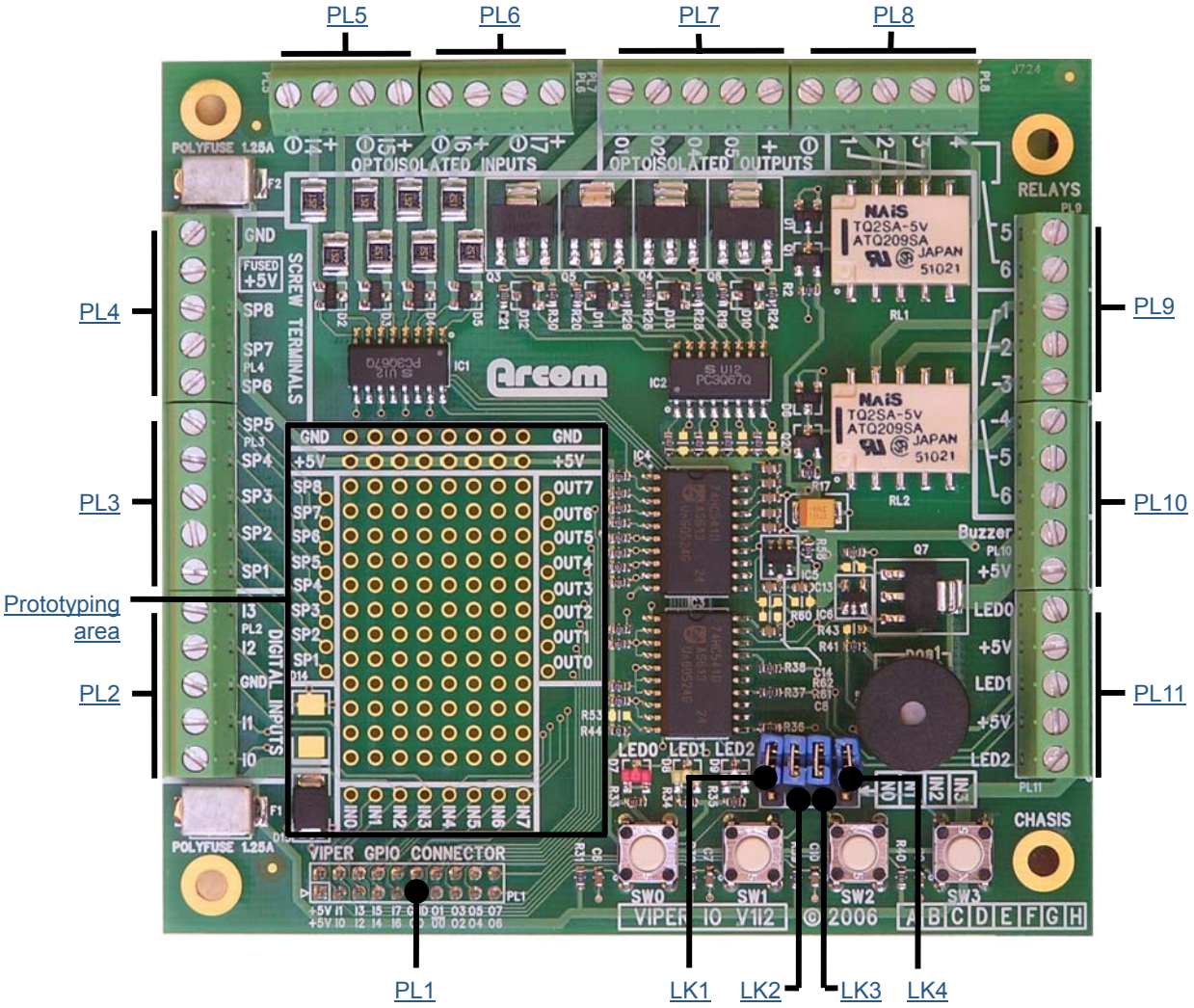
Jumpers, connectors and prototyping area

The following diagram shows the jumpers, connectors and prototyping area on the VIPER-I/O. Click on any name for more information.



Jumpers

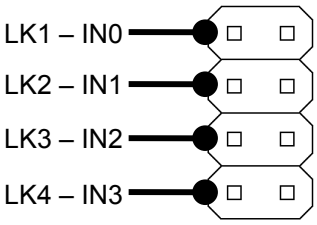
There is one jumper array (JP1) on the VIPER-I/O.

JP1 - Inputs jumper array

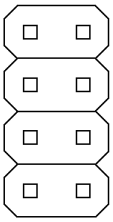
Each part of the jumper array is also connected to one of the inputs (IN0-3).

LKx	Description
	Input pin is connected to Low.
	Input pin is connected to High.

Default setting:



2 x 4 2.54mm pitch header.

Pin	Signal	Pin	Signal	Jumper array drawing
1	IN0	2	GND	
3	IN1	4	GND	
5	IN2	6	GND	
7	IN3	8	GND	

When your board is supplied, the factory default setting is all inputs ‘1’. Jumpers are open.

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Connectors

The VIPER I/O has the following connectors:

- 1 x 20 pin header.
- 8 x 5 pin screw terminals.
- 2 x 4 pin screw terminal.

More information about each individual connector is provided in the following table and in the sections that follow.

Connector	Function	See ...
PL1	GPIO connector.	Page 13.
PL2	Digital inputs screw terminal.	Page 14.
PL3-4	General screw terminal.	Page 15.
PL5-6	Opto-isolated inputs.	Page 16.
PL7-8	Opto-isolated outputs / Relay contacts.	Pages 17 and 18.
PL8-10	Relay contacts / Buzzer output.	Pages 18 and 19.
PL11	LEDs screw terminal.	Page 20.

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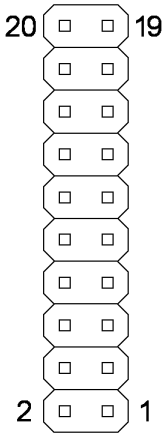
PL1 - GPIO connector

2 x 10 2mm pitch header.

Pin	Signal	Pin	Signal	Header drawing
1	+5V (FUSED)	2	+5V (FUSED)	
3	IN0	4	IN1	
5	IN2	6	IN3	
7	IN4	8	IN5	
9	IN6	10	IN7	
11	OUT0	12	GND	
13	N.C.	14	OUT1	
15	OUT2	16	OUT3	
17	OUT4	18	OUT5	
19	OUT6	20	OUT7	

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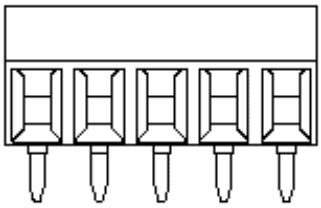
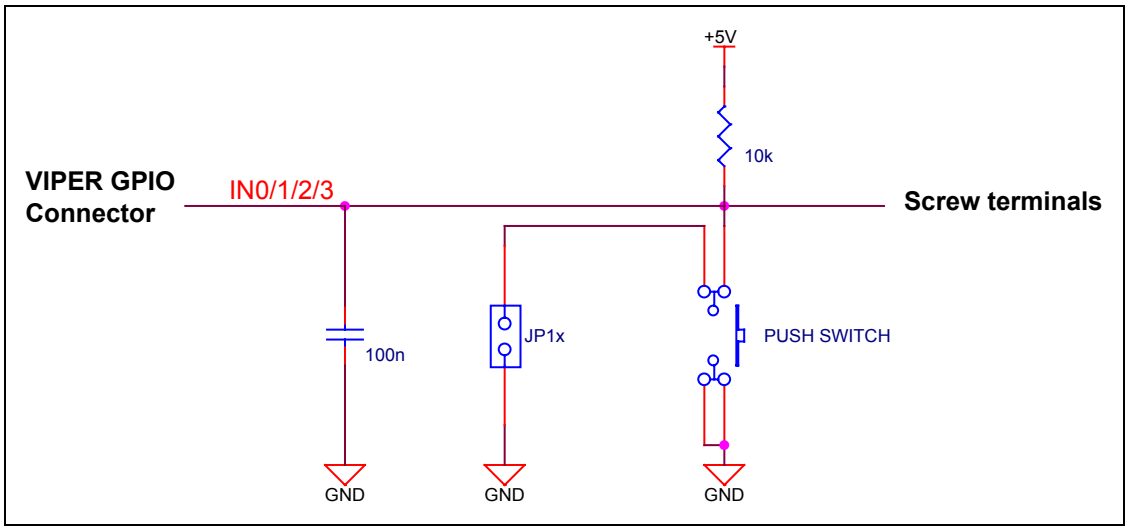
PL2 - Digital inputs from screw terminals, jumper or push switches

This is a 5 way screw terminal.

Pin	Signal	Screw terminal drawing
1	IN0	
2	IN1	
3	GND	
4	IN2	
5	IN3	

Digital inputs are connected directly to the VIPER-I/O connector. The following diagram illustrates the digital inputs connection:

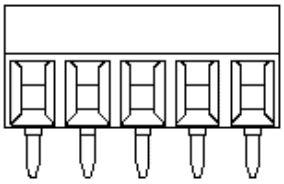


PL3, PL4 - Uncommitted general purpose screw terminals

These screw terminals are uncommitted and may be used with the prototyping area of the board. These connections are routed to the through-hole pads along the edge of the prototyping area. The terminal labelled “FUSED +5V” is connected to the +5V supply via a 1.25A polyfuse.

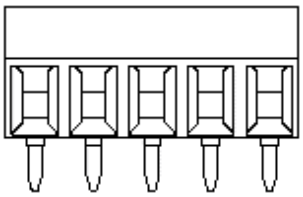
PL3

This is a 5 way screw terminal.

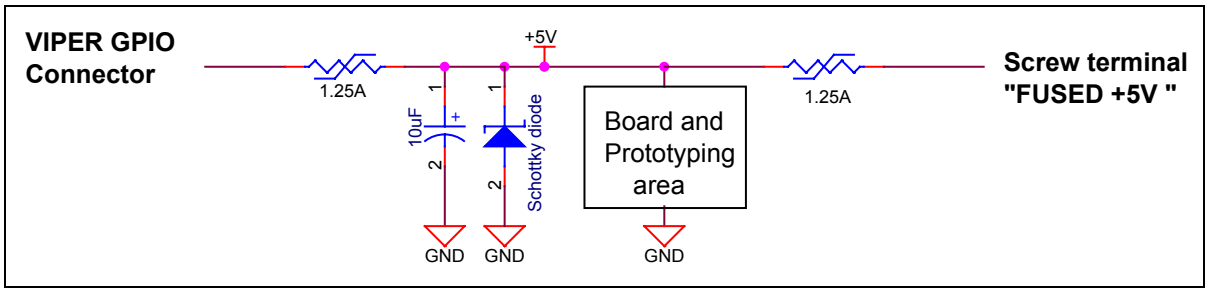
Pin	Signal	Screw terminal drawing
1	SP1	
2	SP2	
3	SP3	
4	SP4	
5	SP5	

PL4

This is a 5 way screw terminal.

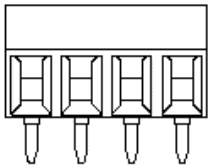
Pin	Signal	Screw terminal drawing
1	SP6	
2	SP7	
3	SP8	
4	FUSED +5V	
5	GND	

The following diagram illustrates the +5V power connection:

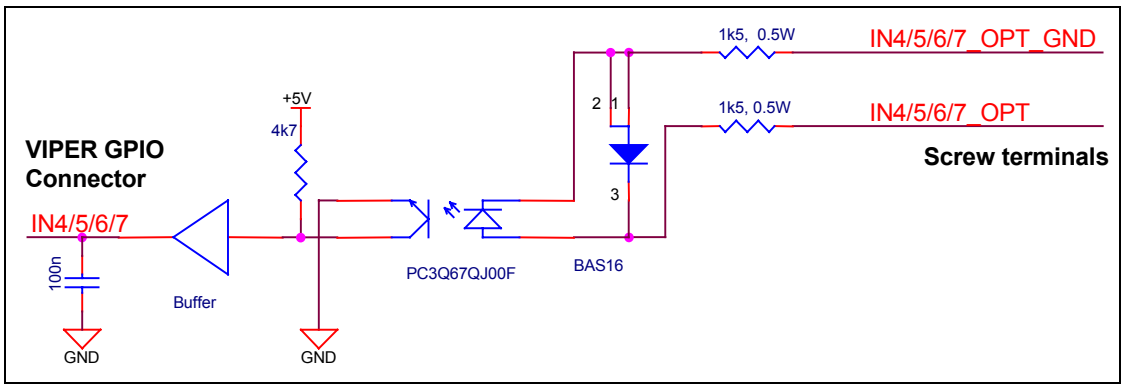


PL5 - Opto-isolated inputs

This is a 4 way screw terminal.

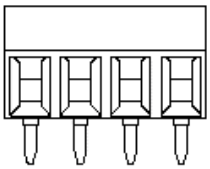
Pin	Designator	Signal	Screw terminal drawing
1	I4 –	IN4_OPT_GND	
2	I4 +	IN4_OPT	
3	I5 -	IN5_OPT_GND	
4	I5 +	IN5_OPT	

Connection of the opto-isolated inputs is illustrated in the following diagram:



PL6 - Opto-isolated inputs

This is a 4 way screw terminal.

Pin	Designator	Signal	Screw terminal drawing
1	I6 -	IN6_OPT_GND	
2	I6 +	IN6_OPT	
3	I7 -	IN7_OPT_GND	
4	I7 +	IN7_OPT	

For a diagram showing connection of the opto-isolated inputs, see above.

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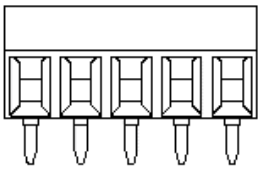
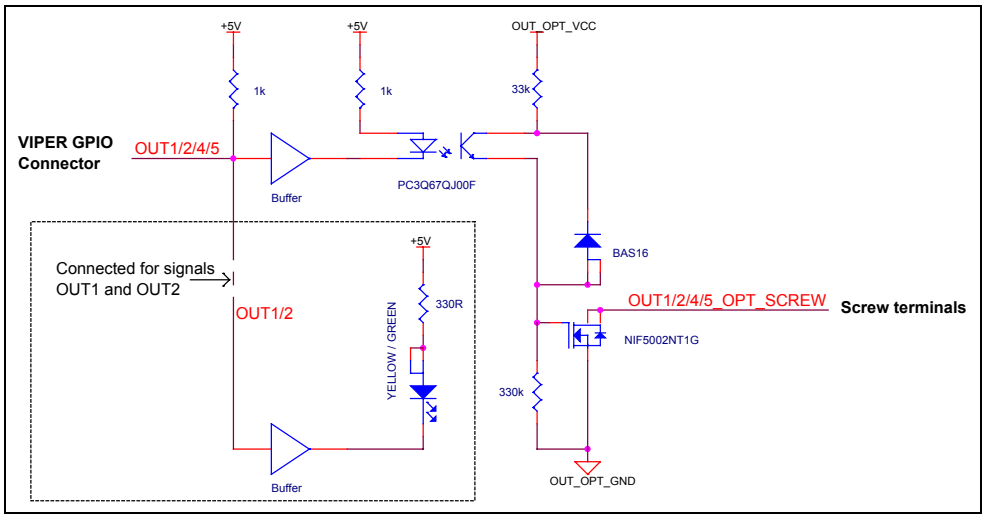
PL7 - Opto-isolated open-drain MOSFET driver

This is a 5 way screw terminal.

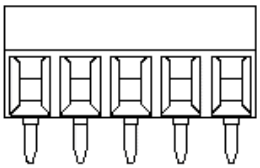
Pin	Designator	Signal	Screw terminal drawing
1	O1	OUT1_OPT_SCREW	
2	O2	OUT2_OPT_SCREW	
3	O4	OUT4_OPT_SCREW	
4	O5	OUT5_OPT_SCREW	
5	OPT VCC	OUT_OPT_VCC	

The following diagram illustrates connection of the opto-isolated open drain MOSFET outputs:

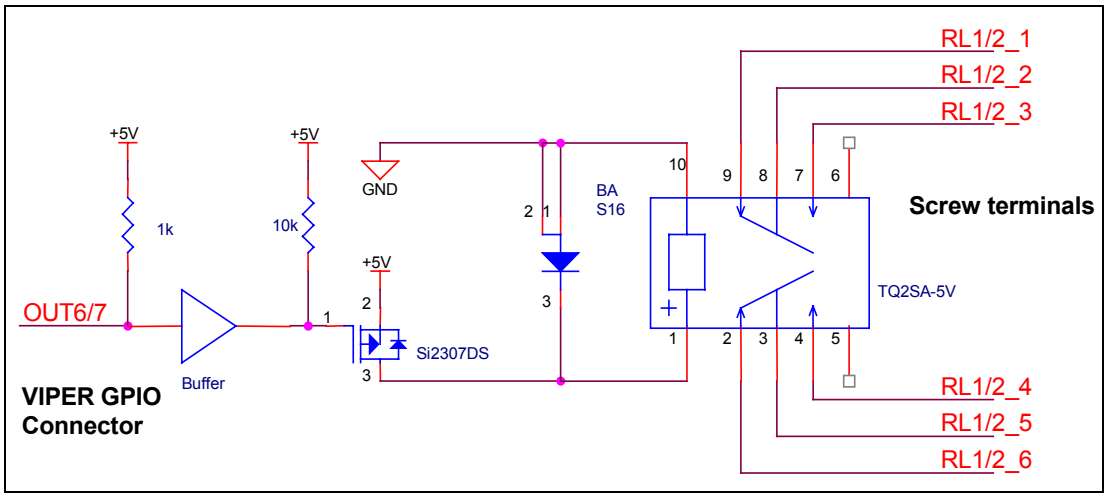


PL8 - Opto-isolated outputs / Relay

This is a 5 way screw terminal.

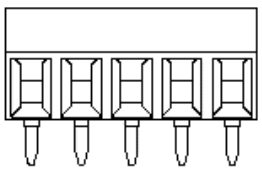
Pin	Designator	Signal	Screw terminal drawing
1	OPT GND	OUT_OPT_GND	
2	RL1 - 1	RL1_1	
3	RL1 - 2	RL1_2	
4	RL1 - 3	RL1_3	
5	RL1 - 4	RL1_4	

The following diagram illustrates the relay connections:



PL9 - Relays

This is a 5 way screw terminal.

Pin	Designator	Signal	Screw terminal drawing
1	RL1 - 5	RL1_5	
2	RL1 - 6	RL1_6	
3	RL2 - 1	RL2_1	
4	RL2 - 2	RL2_2	
5	RL2 - 3	RL2_3	

For a diagram showing relay connections, see above.

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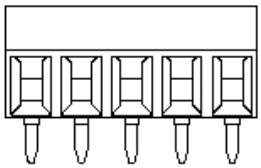
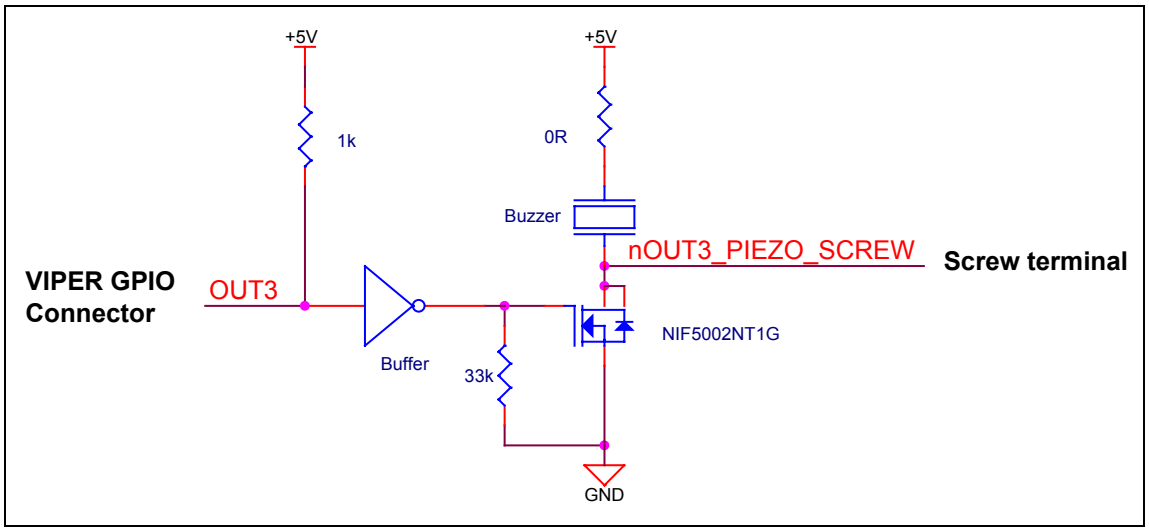
PL10 – Relay/Buzzer

This is a 5 way screw terminal.

Pin	Designator	Signal	Screw terminal drawing
1	RL2 - 4	RL2_4	
2	RL2 – 5	RL2_5	
3	RL2 – 6	RL2_6	
4	Buzzer	NOUT3_PIEZO_SCREW	
5	+5V	+5V	

See page 18 for a diagram showing relay connections.

The following diagram illustrates the buzzer connection:



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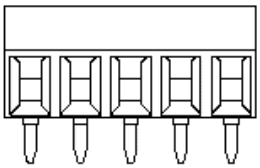
PL11 – LEDs

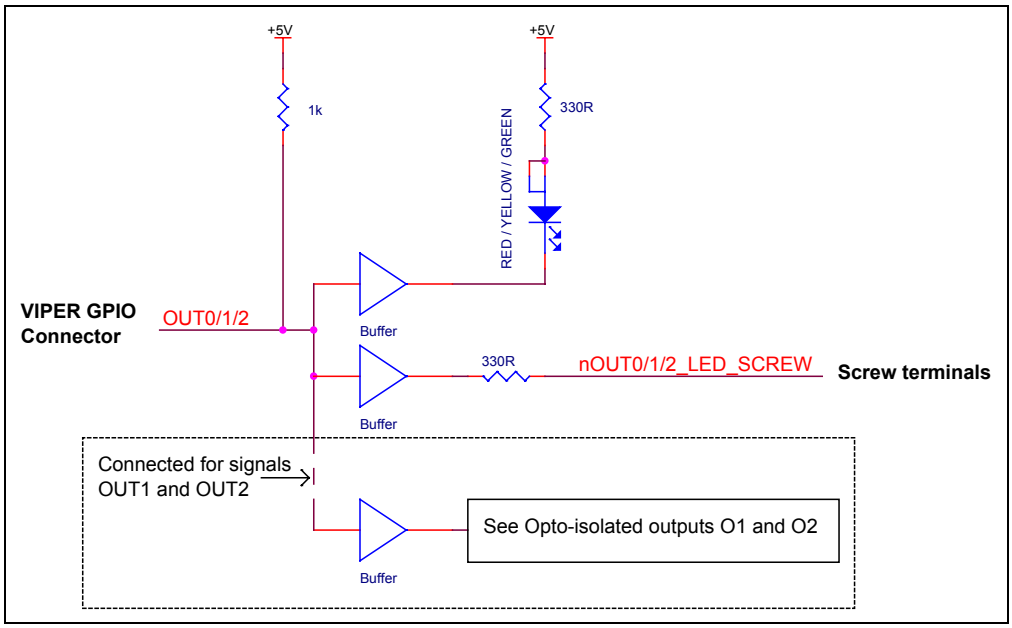
This is a 5 way screw terminal.

Pin	Designator	Screw terminal drawing
1	LED0 (Red)	
2	+5V	
3	LED1 (Yellow)	
4	+5V	
5	LED2 (Green)	

LED1 and opto-isolated output 1 (O1) are both controlled by GPIO output bit 1 (OUT1).

LED2 and opto-isolated output 2 (O2) are both controlled by GPIO output bit 2 (OUT2).

The following diagram illustrates the LEDs connection:

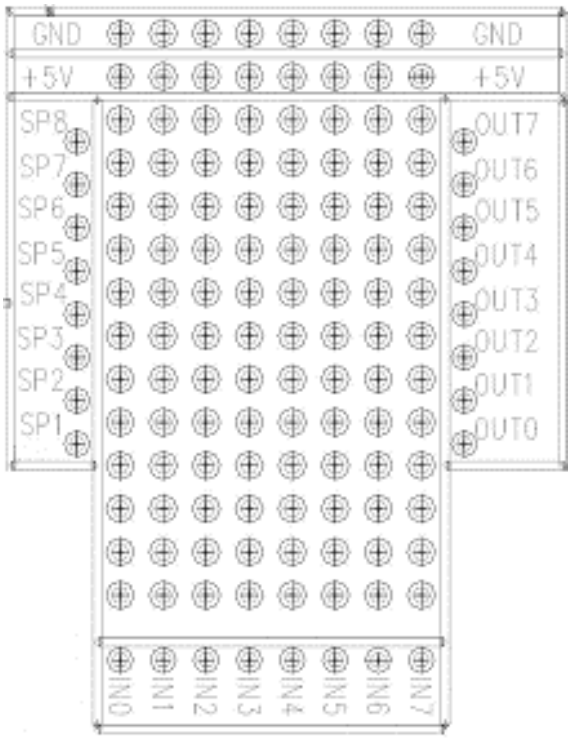


Prototyping area

14 x 8 plus 2 x 8 pads for prototyping area (0.1" pitch holes).

Pin	Connected to...
SP1	Screw terminal SP1
SP2	Screw terminal SP2
SP3	Screw terminal SP3
SP4	Screw terminal SP4
SP5	Screw terminal SP5
SP6	Screw terminal SP6
SP7	Screw terminal SP7
SP8	Screw terminal SP8
IN0	VIPER GPIO connector IN0
IN1	VIPER GPIO connector IN1
IN2	VIPER GPIO connector IN2
IN3	VIPER GPIO connector IN3
IN4	VIPER GPIO connector IN4
IN5	VIPER GPIO connector IN5
IN6	VIPER GPIO connector IN6
IN7	VIPER GPIO connector IN7
OUT0	VIPER GPIO connector OUT0
OUT1	VIPER GPIO connector OUT1
OUT2	VIPER GPIO connector OUT2
OUT3	VIPER GPIO connector OUT3
OUT4	VIPER GPIO connector OUT4
OUT5	VIPER GPIO connector OUT5
OUT6	VIPER GPIO connector OUT6
OUT7	VIPER GPIO connector OUT7
GND	Ground
+5V	+5V

Prototyping area drawing

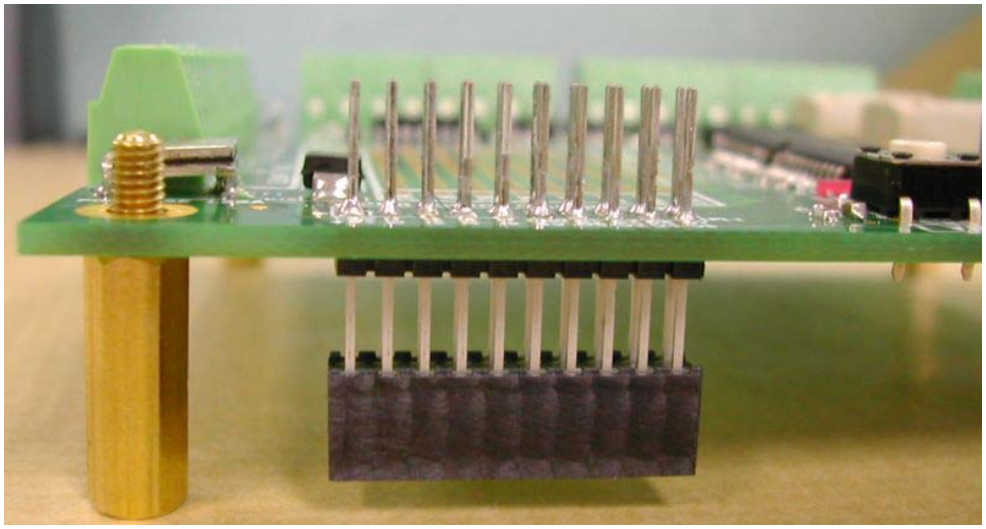


Using the VIPER-I/O board

The following sections provide a more detailed explanation of the main features of the VIPER-I/O board.

GPIO connector

On the GPIO connector (PL1) are TTL inputs, TTL outputs and power pins:



PL1 can be connected to a VIPER PL9 (GPIO) connector via cable or board-to-board connector. The PL1 pin-out is designed for direct connection via a 20-way ribbon cable with a 20-way 2mm header.

Polyfuse 1.25A is placed in +5V.

If you are using cable, make sure you check pin 1.

Please note:

- Opto-isolated and relay outputs are inactive when OUT bits are 1111111Xb: 1 - High voltage level; X - don't care.
- OUT0B signal is not used.

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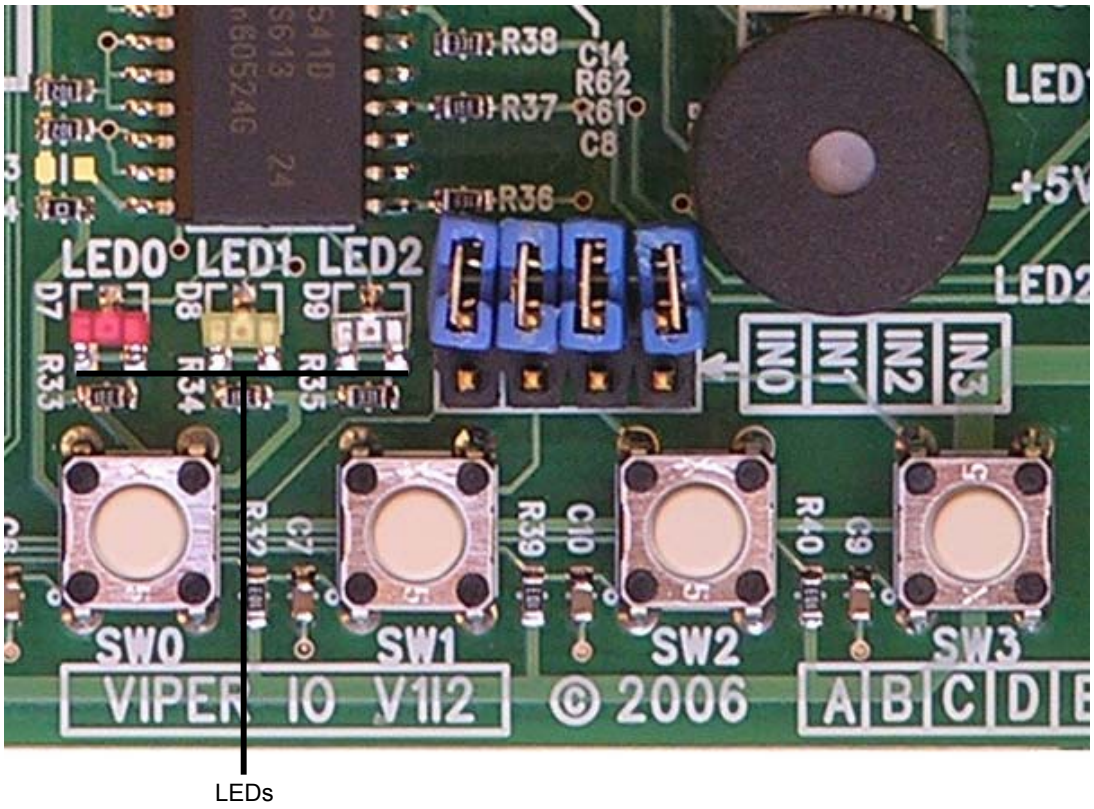
LEDs

The LEDs on the VIPER-I/O are shown in the following picture:



The LEDs are driven via OUT0-2 pins on GPIO connector. If the output is high the LEDs are OFF.

The following table shows the GPIO connector pins that each LED connects to:

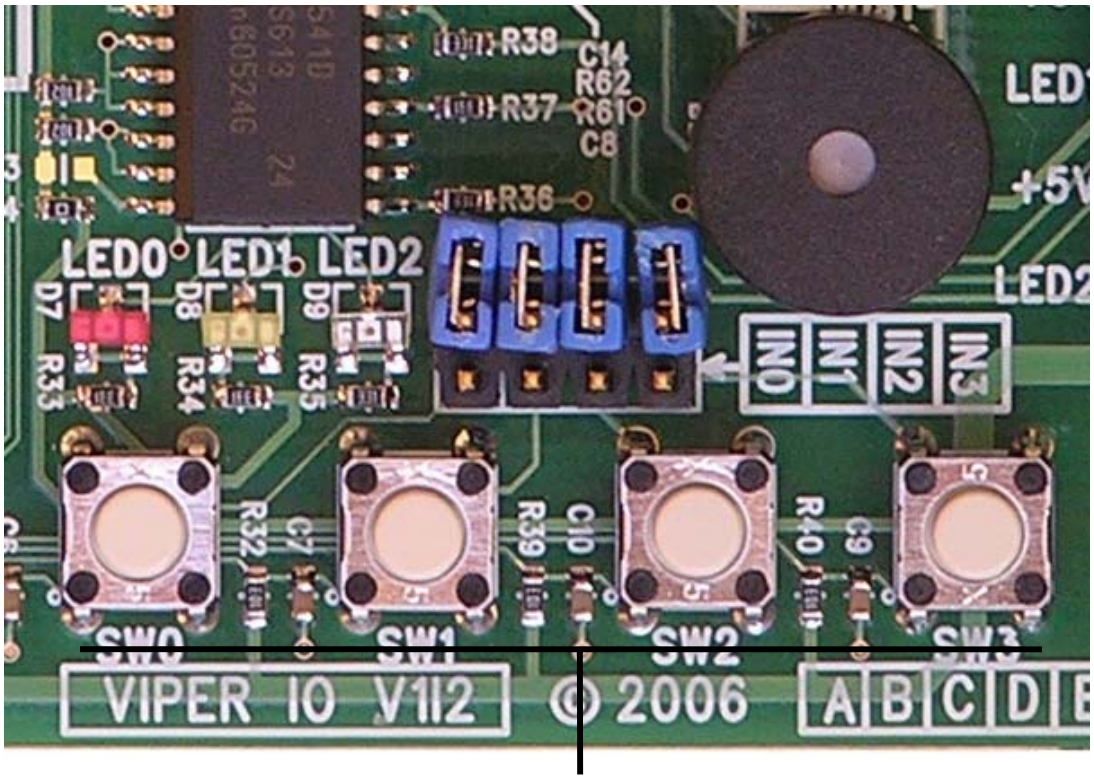
LED	GPIO connector pin
LED0 (Red)	OUT0
LED1 (Yellow)	OUT1
LED2 (Green)	OUT2

Please note:

- LED1 and LED2 are driven together with opto-isolated outputs O1 and O2.
- External LEDs can be connected via the SCREW terminal. Simply connect the LED's cathode to the screw terminal LED output and the LED's anode to +5V on the screw terminal. On board resistor 330R is connected in series with LED.

SWITCHes

The SWITCHes on the VIPER-I/O are shown in the following picture:



The SWITCHes are connected to IN0-3 pins on a GPIO connector. The default level on the input pin is High. When SWITCH is pushed, the value is changed to Low.

The following table shows the GPIO connector pin that each SWITCH connects to:

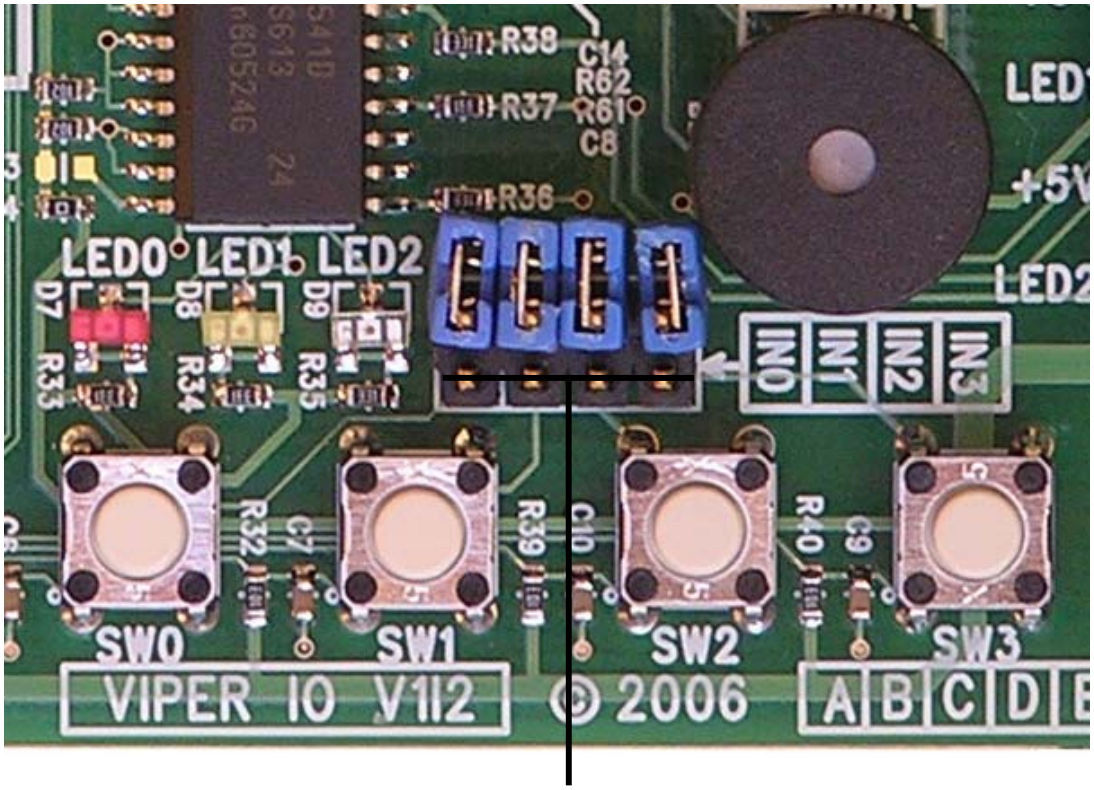
SWITCH	GPIO connector pin
SW0	IN0
SW1	IN1
SW2	IN2
SW3	IN3

Please note:

- External SWITCHes can be connected via a screw terminal. Just connect one pin of the switch to one digital input on the screw terminal and the next pin to GND on the screw terminal.
- When jumper header JP1 is used (see page 11), make sure that the input from the screw terminal is not fitted.

Jumpers array

The jumpers array on the VIPER-I/O is shown in the following image:

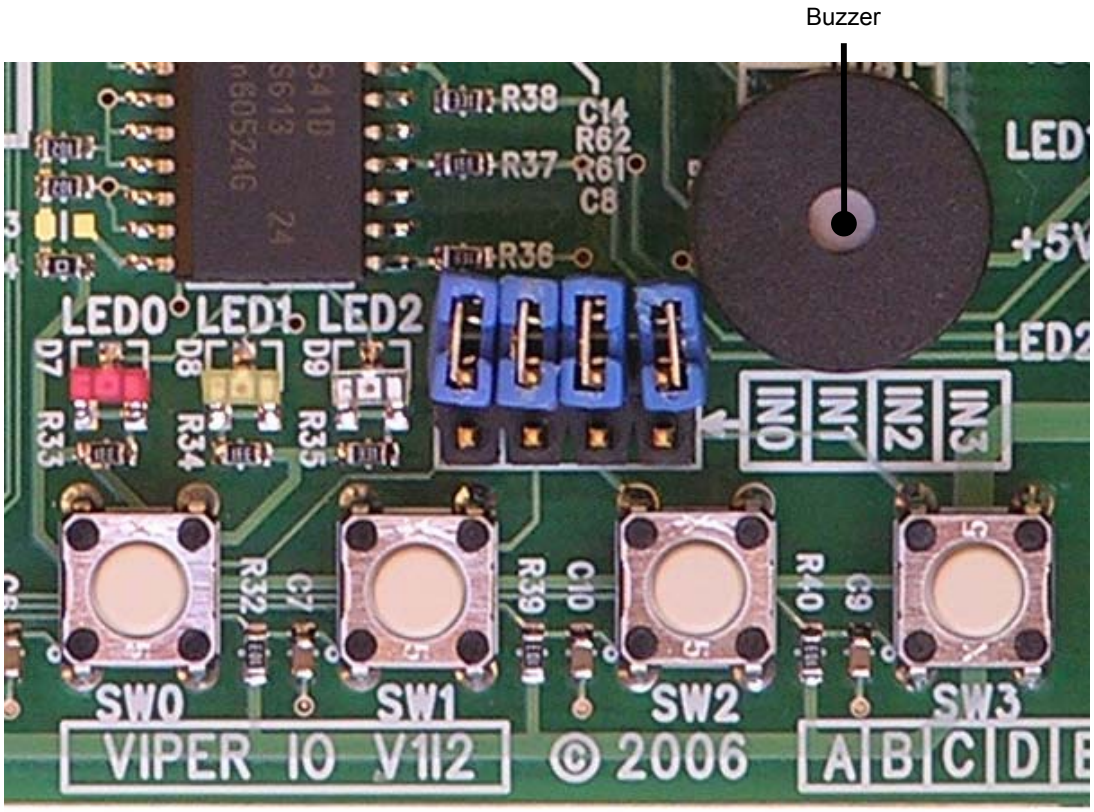


The jumpers array can set IN0-IN3 to Low level when jumpers are fitted.

When a jumper is used, IN level is always Low. If a jumper is not used, IN level can be High (default) or Low (press switch).

Buzzer

The buzzer on the VIPER-I/O is shown in the following picture:



The buzzer is controlled by the OUT3 pin on the I/O connector (see page 13).

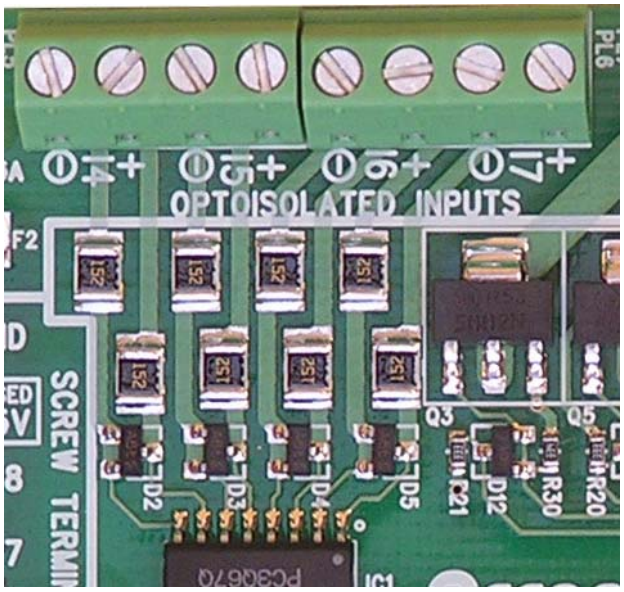
The buzzer is OFF when OUT3 pin level is High; it is ON (continuous tone is generated) when OUT3 pin level is Low.

Please note:

- An external buzzer can be connected via the screw terminal. Connect the minus pin of the buzzer to the screw terminal buzzer output, and the plus pin to +5V on the screw terminal.
- The buzzer screw terminal output can be also used as a general purpose output. In this case you must take care because this output is not opto-isolated.
- Buzzer volume can be changed with a new value of resistor R41 (R41=0R default). Change R41=330R for quiet volume.

Opto-isolated inputs

The opto-isolated inputs on the VIPER-I/O are shown in the following picture:



The inputs value can be read from pins IN4-7 on the GPIO connector. The default read value from the unconnected input is 1 (High level). If the voltage connected between the opto-isolated input + and - is higher than +3.0V, the input level goes Low.

Each input has two lines, one positive and one negative. The negative line should be connected to ground of a system which drives the input pin. The positive line should be connected to the system output pin.

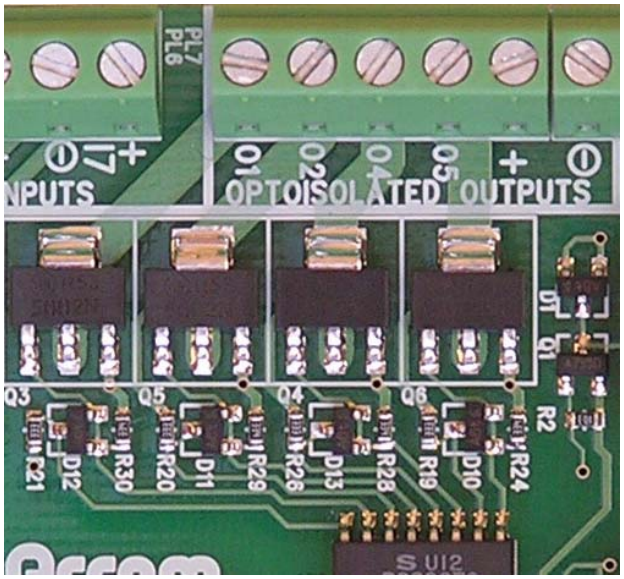
The following table shows the GPIO connector pin from which the level of each opto-isolated input can be read:

Opto-isolated input	GPIO connector pin
I4	IN4
I5	IN5
I6	IN6
I7	IN7

Always check polarity.

Opto-isolated open-drain MOSFET driver (opto-isolated outputs)

The opto-isolated outputs on the VIPER-I/O are shown in the following picture:



The outputs are controlled by the OUT1,2,4,5 pins on the GPIO connector.

- If board power (+5V) is OFF = Transistors are CLOSED.
- If High level is on pin OUT1/2/4/5 = Transistor is CLOSED.
- If Low level is on pin OUT1/2/4/5 = Transistor is OPEN.

The following table shows the GPIO connector pin that drives each opto-isolated output:

Opto-isolated output	GPIO connector pin
O1	OUT1
O2	OUT2
O4	OUT4
O5	OUT5

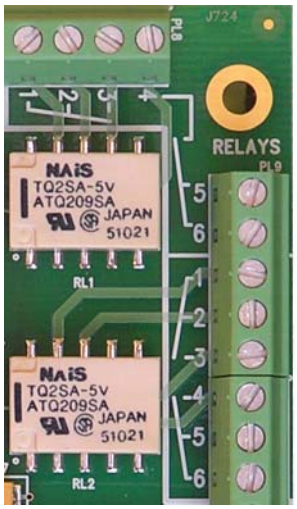
If opto-isolated outputs are used, this circuit should be powered via + (OPT_VCC) and - (OPT_GND) lines.

Take care with power polarity.

LED1 and LED2 are driven together with opto-isolated outputs O1 and O2. The LEDs can be used for visual signalization of the output status.

Relays

Two relays are controlled by OUT6 and OUT7 pins. The following picture illustrates the Relay 1 and Relay 2 connections:



Relay 1

Relay 1 is controlled by pin OUT6. Relay 1 contacts are RL1 - 1 to 6.

If OUT6 is High (default):

- RL1 – 1 and RL1 – 2 (middle contact) are connected.
- RL1 – 5 (middle contact) and RL1 – 6 are connected.

If OUT6 is Low:

- RL1 – 2 (middle contact) and RL1 – 3 are connected.
- RL1 – 4 and RL1 – 5 (middle contact) are connected.

Relay 2

Relay 2 is controlled by pin OUT7. Relay 2 contacts are RL2 - 1 to 6.

If OUT7 is High (default):

- RL2 – 1 and RL2 – 2 (middle contact) are connected.
- RL2 – 5 (middle contact) and RL2 – 6 are connected.

If OUT7 is Low:

- RL2 – 2 (middle contact) and RL2 – 3 are connected.
- RL2 – 4 and RL2 – 5 (middle contact) are connected.

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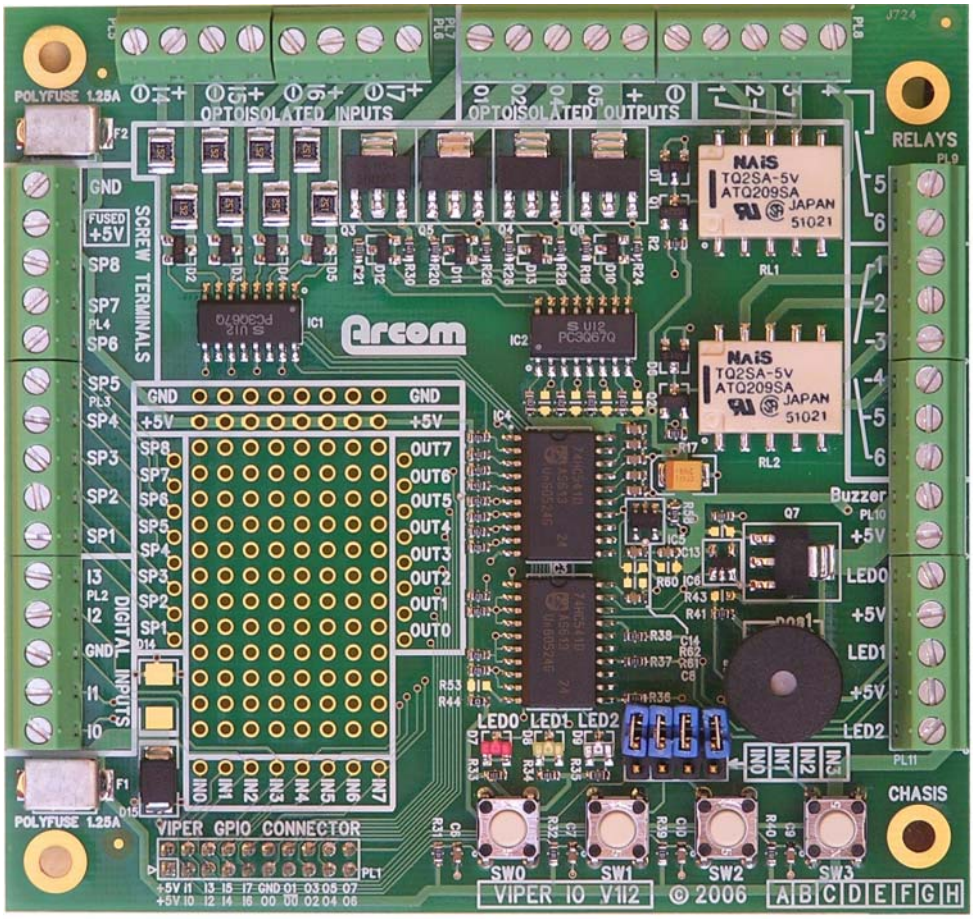
Screw terminals

The screw terminals on the VIPER-I/O are shown in the following picture:

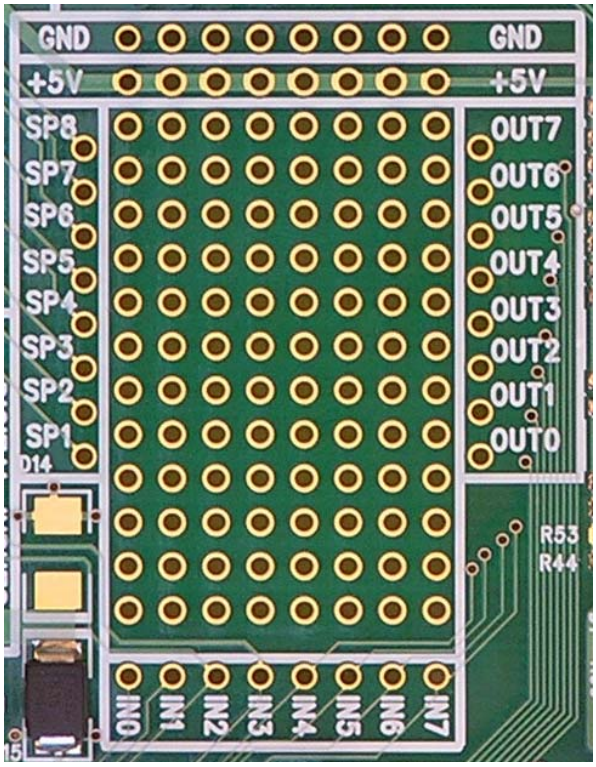


Screw terminals can be used for connecting external circuits.

Always check the function of pins and wires.

Prototyping area

The prototyping area with VIPER-I/O pads is shown in the following picture:



The prototyping area can be used for custom circuits. GPIO inputs, outputs and screw terminal pads are placed at the edges of the prototyping area. The pitch of the area is 0.1" and the standard header can be placed there.

Don’t forget that output and input pins are connected directly to the VIPER board.

Power supply

The VIPER-I/O should be powered from the VIPER board with +5V DC. Current consumption of the board is typically from 0.06mA (OUT=0xFF) to 110mA (OUT=0x00).

Powering the board with the incorrect polarity or with a voltage higher than +6V may damage the board and will invalidate the warranty.

Operating conditions

The following sections provide information about:

- The conditions under which the VIPER I/O functions optimally. See Recommended operating conditions, below.
- The conditions that should not be exceeded when using the VIPER I/O. See Limiting values, page 34.

Recommended operating conditions

It is recommended that you use the VIPER I/O under the following conditions:

Power supply	Power supply voltage: +4.6V to +5.5V.
GPIO connector input level	Minimum input voltage: 0V. Maximum input voltage: +5V. High level input voltage: min 2V. Low level input voltage: max 0.8V.
Opto-isolated inputs	Minimum input voltage: +5V. Maximum input voltage:+30V. Maximum frequency: 2.5kHz.
Opto-isolated open-drain MOSFET driver	Minimum power voltage: +5V. Maximum power voltage: +30V. Maximum current: 1A. Maximum frequency: 500Hz.
Relay contacts	Nominal switching capacity (resistive load) 2A 30V DC, 0.5A 125V AC.
Digital inputs	Minimum input voltage: 0V. Maximum input voltage: +5V. High level input voltage: min 2V. Low level input voltage: max 0.8V.
LED outputs	High level output: VCC (typically +5V). Low level output: VoutL= 0V. Maximum current: 13mA.

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Buzzer output	Maximum voltage: +5V. Maximum current: 1A.
Temperature	Operating ambient temperature range: -25°C (-13°F) ~ +70°C (158°F).

Limiting values

Use of the board is subject to the following limiting values:

Power supply	DC power supply voltage: -0.5V to + 6.0V. Protection: Reverse input protection diode, 1.25A polyfuse.
GPIO connector input level	DC Input Voltage -0.5 to +6.0V.
Opto-isolated inputs	Maximum input voltage 42V. Input isolation voltage is: 1000V. Protection: Reverse input protection diodes.
Opto-isolated open-drain MOSFET driver	Maximum current: 2A. Maximum power voltage: 42V. Output isolation voltage is: 1000V. Protection: Reverse input protection diodes.
Relay contacts	Maximum switching power (resistive load): 60 W, 62.5VA. Maximum switching voltage: 220V DC, 125V AC. Maximum switching current: 2A.
Digital inputs	DC Input Voltage -0.5 to +6.0V.
Buzzer output	Maximum voltage +6.0V. Maximum current: 2A.
Temperature	Storage temperature: -25°C (-13°F) ~ +70°C (158°F).

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Appendix A - Contacting Arcom

Arcom sales

Arcom's sales team is always available to assist you in choosing the board that best meets your requirements. Contact your local sales office or hotline.

Sales office US

Arcom
7500W 161st Street
Overland Park
Kansas
66085
USA

Tel: 913 549 1000
Fax: 913 549 1002
E-mail: us-sales@arcom.com

Sales office UK

Arcom
Clifton Road
Cambridge
CB1 7EA
UK

Tel: 01223 411 200
Fax: 01223 410 457
E-mail: sales@arcom.co.uk

Comprehensive information about our products is available from our web sites: www.arcom.com and www.arcom.co.uk.

While Arcom's sales team can assist you in making your decision, the final choice of boards or systems is solely and wholly the responsibility of the buyer. Arcom's entire liability in respect of the boards or systems is as set out in Arcom's standard terms and conditions of sale. If you intend to write your own low level software, you can start with the source code on the disk supplied. This is example code only to illustrate use on Arcom's products. It has not been commercially tested. No warranty is made in respect of this code and Arcom shall incur no liability whatsoever or howsoever arising from any use made of the code.

Technical support

Arcom has a team of technical support engineers available to provide a quick *and free* response to your technical queries.

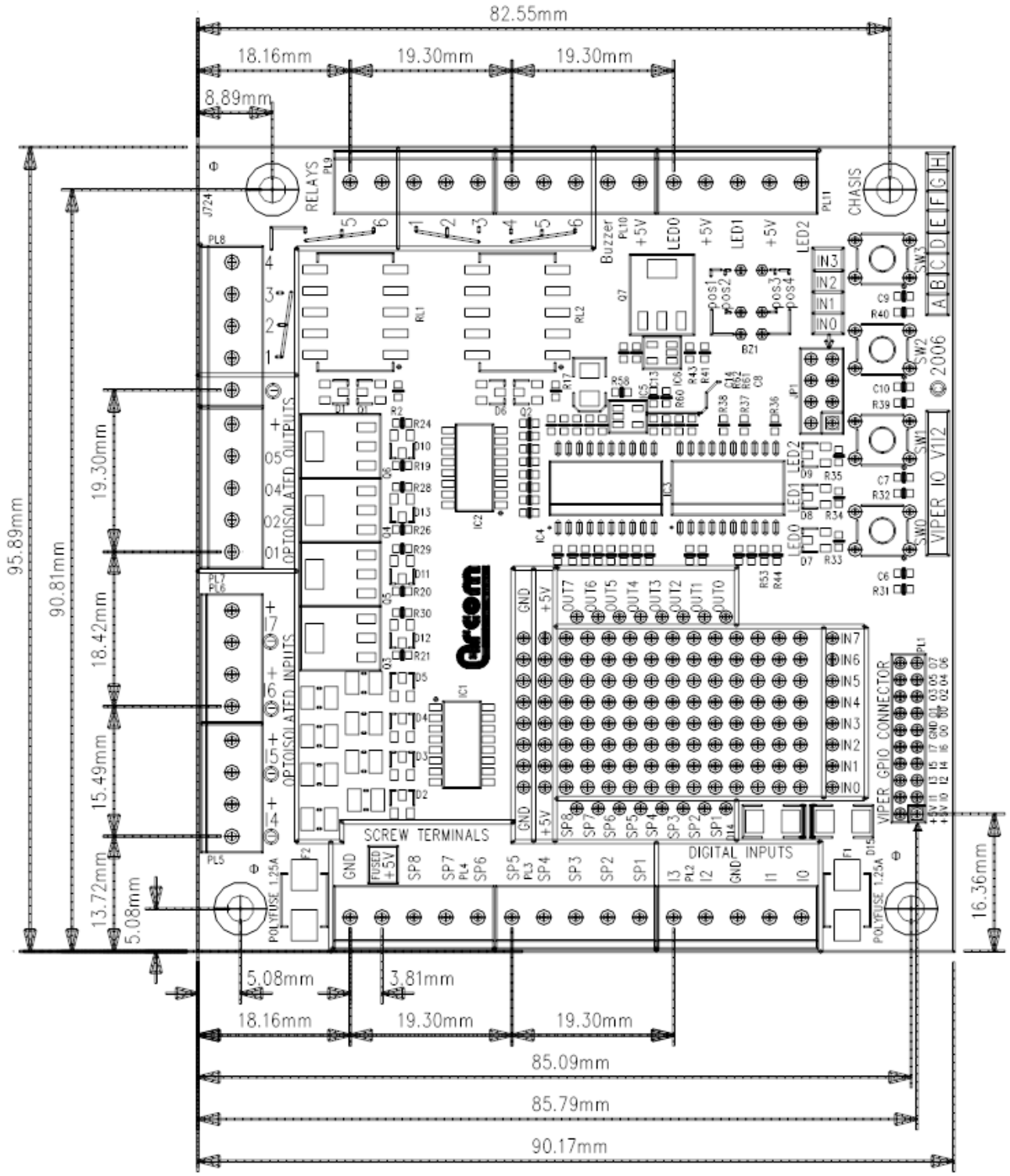
Technical support US

Tel: 913 549 1010
Fax: 913 549 1001
E-mail: us-support@arcom.com

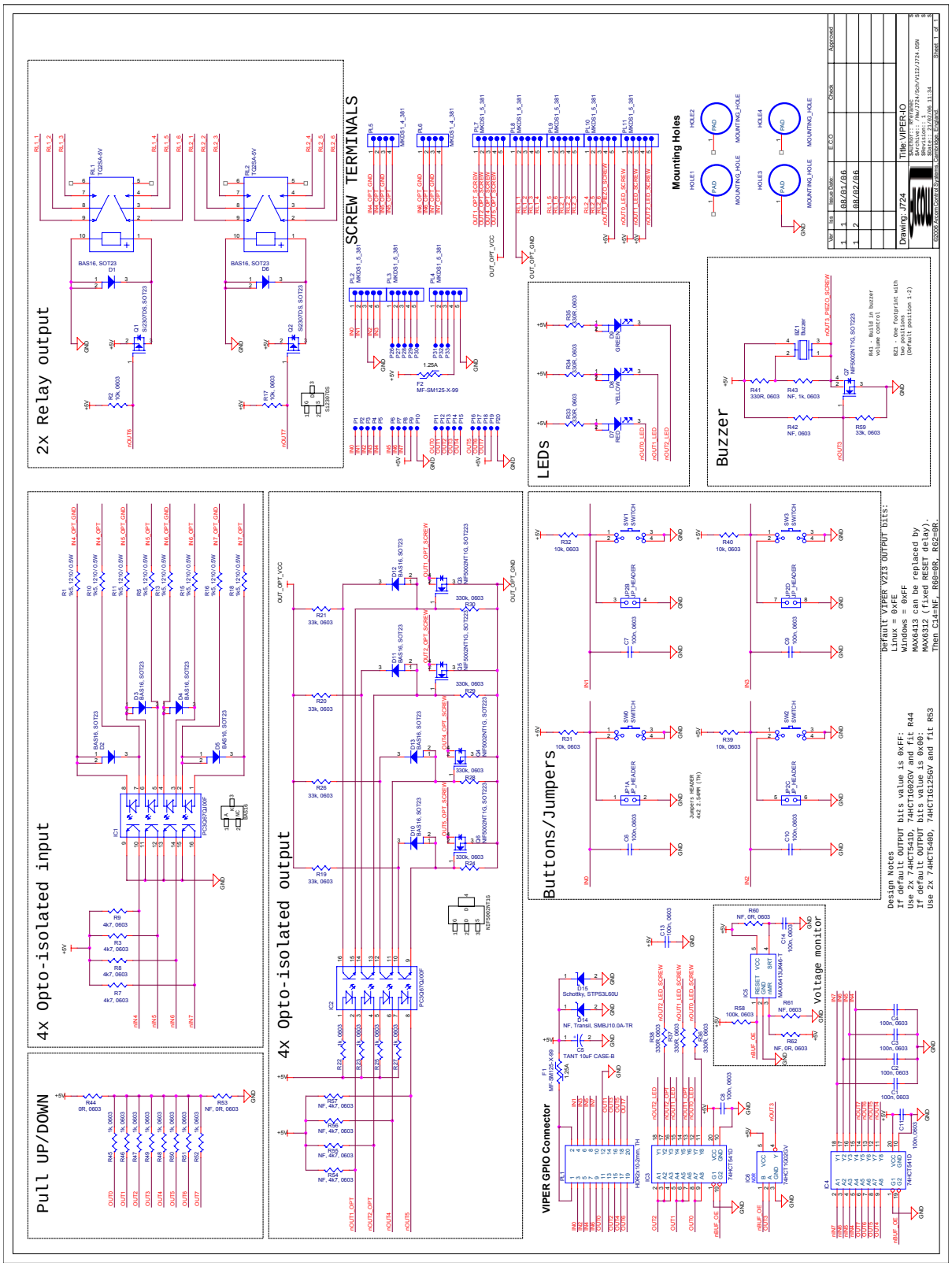
Technical support UK

Tel: +44 (0)1223 412 428
Fax: +44 (0)1223 403 409
E-mail: euro-support@arcom.com

Appendix B - Dimensional information



Appendix C - Schematic



Appendix D - RoHS-6 Compliance - Materials Declaration Form

Confirmation of environmental compatibility for supplied products

Arcom Control Systems certifies that the products described below comply with the maximum concentrations of the following substances, as required by the RoHS Directive (Directive 2002/95/EC):

Substance	Maximum concentration
Lead	0.1% by weight in homogeneous materials
Mercury	0.1% by weight in homogeneous materials
Hexavalent chromium	0.1% by weight in homogeneous materials
Polybrominated biphenyls (PBBs)	0.1% by weight in homogeneous materials
Polybrominated diphenyl ethers (PBDEs)	0.1% by weight in homogeneous materials
Cadmium	0.01% by weight in homogeneous materials

The products covered by this certificate include:

Product name	Arcom part number
VIPER IO V1I2 - R6	6570-50724-001-102

Arcom has based its material content knowledge on a combination of information provided by third parties and auditing our suppliers and sub-contractor's operational activities and arrangements. This information is archived within the associated Technical Construction File. Arcom has taken reasonable steps to provide representative and accurate information, though may not have conducted destructive testing or chemical analysis on incoming components and materials.

Additionally, packaging used by Arcom for its products complies with the EU Directive 2004/12/EC in that the total concentration of the heavy metals cadmium, hexavalent chromium, lead and mercury do not exceed 100 ppm.

Signature:

Name/title: Glen Middleton, Managing Director, Arcom Control Systems Ltd

Date: 27th March 2006

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Appendix E - Reference information

Product information

Product notices, updated drivers, support material, 24 hour online ordering:

www.arcom.com

VIPER information

Information about VIPER board:

http://www.arcom.com/pc104-xscale-viper.htm

Appendix F - Acronyms and abbreviations

A/D	Analog to Digital
CMOS	Complementary Metal Oxide Semiconductor
DC	Direct Current
EMC	Electromagnetic Compatibility
FCI	Framatome Connectors International
GPIO	General Purpose Input Output
IDC	Internet Database Connector
LED	Light Emitting Diode
MOSFET	Metal Oxide on Silicon Field Effect Transistor
MTBF	Mean Time Between Failures
PC	Personal Computer
PCB	Printed Circuit Board
RF	Radio Frequency
RS	Recommended Standard
TFT	Thin Film Transistor

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